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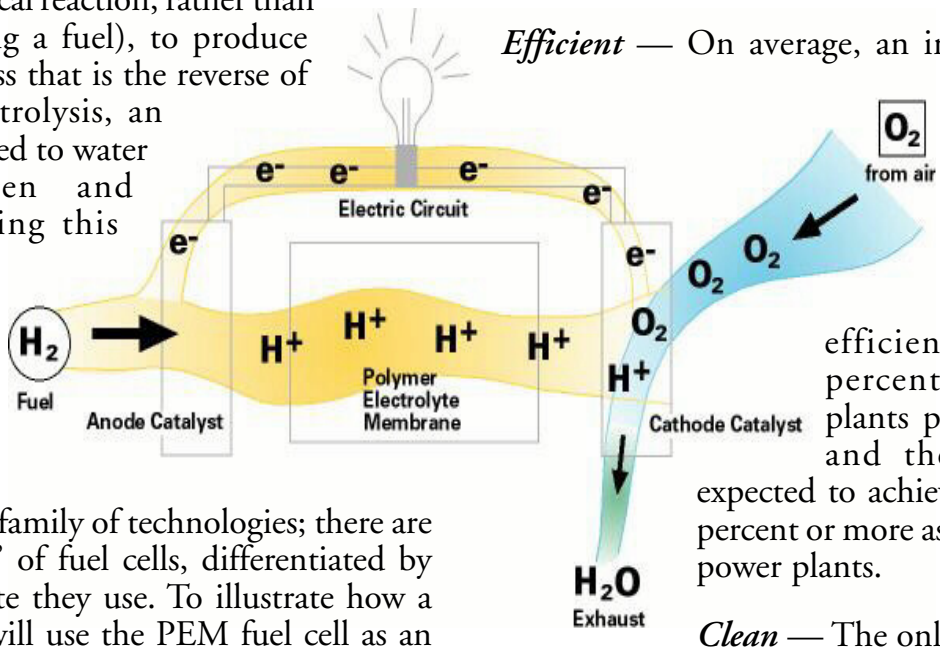
US Fuel Cell Council

Fuel Cells: The Basics

In 1839, Sir William Robert Grove, a Welsh physician, discovered that hydrogen and oxygen could be combined to produce water and an electric current. In the 1950s, scientists would utilize this discovery to develop fuel cells to power NASA's space exploration vehicles. Today, fuel cell technology is being brought back to earth to power everything from cars and buses, to homes and businesses, and even cellular phones and laptop computers.

How the Fuel Cell Works

Fuel cells use a chemical reaction, rather than combustion (burning a fuel), to produce electricity in a process that is the reverse of electrolysis. In electrolysis, an electric current applied to water produces hydrogen and oxygen. By reversing this process, hydrogen and oxygen are combined in the fuel cell to produce electricity and water.



Fuel cells are really a family of technologies; there are several major "types" of fuel cells, differentiated by the type of electrolyte they use. To illustrate how a fuel cell works, we will use the PEM fuel cell as an example.

Hydrogen (fuel) is fed into the anode of the fuel cell. Oxygen (from air) is fed into the cathode side. Encouraged by a catalyst, electrons are stripped from the hydrogen atom. Freed of the electrons, the protons pass through the electrolyte, while the electrons are forced to take a different path to the cathode. As the electrons travel their separate path, they create an electric current that can be utilized. At the cathode, another catalyst rejoins the hydrogen atom, which then combines with oxygen to create a molecule of water.

Hydrogen for Fuel Cells

Hydrogen can be generated using solar and wind powered electrolysis of water, or can be extracted from a variety of hydro-carbon fuels. A fuel cell system that includes a "fuel reformer" can extract hydrogen from a variety of fuels, including methanol, ethanol, natural gas, propane, gasoline, and even landfill gas.

Benefits of Fuel Cells

Fuel cells are better than traditional power technologies because they are:

Efficient — On average, an internal combustion engine converts about 15 percent of the energy in gasoline to turn a car's wheels. Fuel cell vehicles are expected to achieve efficiencies of 40 to 45 percent. Fuel cell power plants producing electricity and thermal energy are expected to achieve efficiencies of 80 percent or more as combined heat and power plants.

Clean — The only emission from the tailpipe of a fuel cell vehicle operating on hydrogen is water vapor. Fuel cell vehicles that use an on-board fuel reformer will emit two-thirds less pollution than a gasoline combustion engine.

Reliable — Because they are modular, fuel cell systems have demonstrated 99.9999% reliability, which is very desirable by companies concerned about financial losses due to power outages.

For more information, visit our web site at www.usfcc.com.

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